



TESS Data Release Notes: Sectors 42 – 43, Multi-sector Search, DR63

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Acknowledgements

These Data Release Notes provide information on the processing and export of data from the Transiting Exoplanet Survey Satellite (TESS). This data release is a combined, multi-sector transit search only. The underlying data products from individual observing sectors have been previously released. The data products included in this data release are the Data Validation (DV) reports, time series, and associated xml files for the threshold crossing events (TCEs) found by searching a combined data set including data from multiple observing sectors.

These data products were generated by the TESS Science Processing Operations Center (SPOC, [Jenkins et al., 2016](#)) at NASA Ames Research Center from data collected by the TESS instrument, which is managed by the TESS Payload Operations Center (POC) at Massachusetts Institute of Technology (MIT). The format and content of these data products are documented in the [Science Data Products Description Document \(SDPDD\)](#)¹. The SPOC science algorithms are based heavily on those of the Kepler Mission science pipeline, and are described in the Kepler Data Processing Handbook ([Jenkins, 2020](#))². The Data Validation algorithms are documented in [Twicken et al. \(2018\)](#) and [Li et al. \(2019\)](#). The [TESS Instrument Handbook](#) ([Vanderspek et al., 2018](#)) contains more information about the TESS instrument design, detector layout, data properties, and mission operations.

The TESS Mission is funded by NASA's Science Mission Directorate.

This report is available in electronic form at
<https://archive.stsci.edu/tess/>

¹<https://archive.stsci.edu/missions/tess/doc/EXP-TESS-ARC-ICD-TM-0014-Rev-F.pdf>

²<https://archive.stsci.edu/kepler/manuals/KSCI-19081-003-KDPH.pdf>

1 Data

TESS Data Release DR63 consists of results from a transiting planet search conducted with the combined data from Sectors 42 and 43 (TESS Year 4 – ecliptic plane pointings). Figure 1 shows the Right Ascension (RA) and Declination (Dec) of all two-minute targets. Targets with data in both Sectors 42 and 43 were subjected to a multi-sector planet search. Table 1 provides basic information and data release numbers for the observations of each sector. The observations span a 51.2 day period.

Table 2 summarizes the total number of targets with multi-sector data for this data release. A supplemental table³ lists the targets searched, including a string indicating which sectors the target was observed in, whether or not the target produced a TCE, and whether or not the target completed DV analysis.

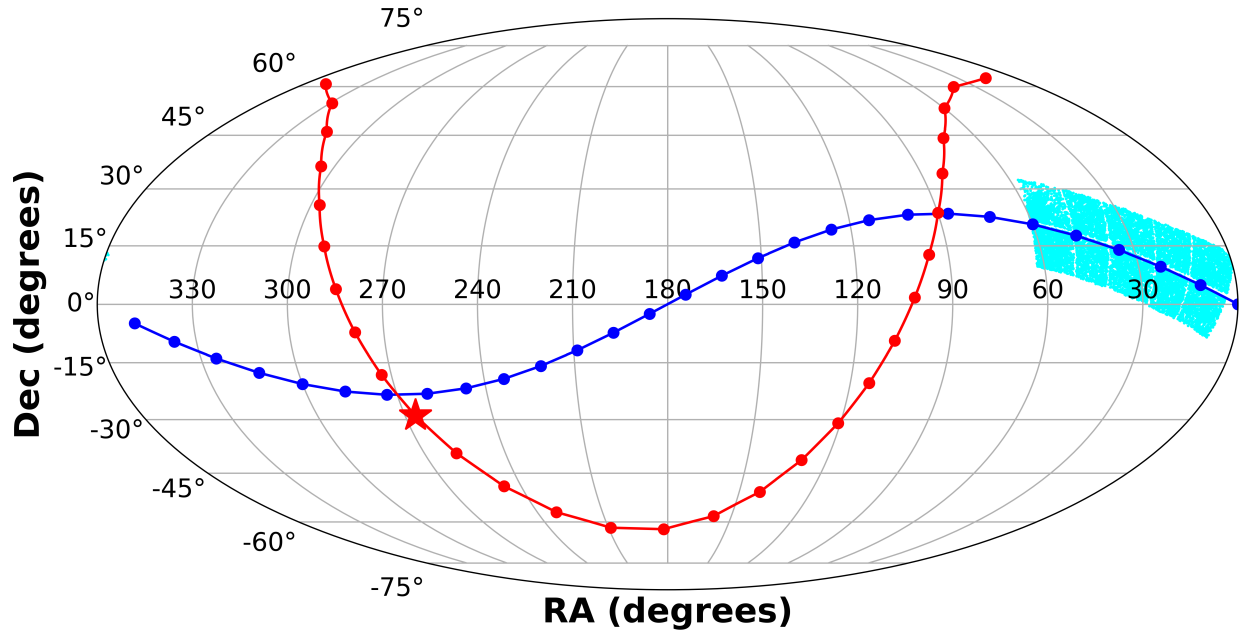


Figure 1: Right Ascension and Declination for TESS two-minute targets included in this multi-sector search. The galactic and ecliptic planes are indicated by the red and blue lines, respectively.

2 Transit Search and Data Validation

The light curves of 11160 targets observed in Sectors 42 and 43 were subjected to the transit search in TPS. Figure 2 shows the 1-hour CDPF for the combined light curves of these targets. Threshold Crossing Events (TCEs) at the 7.1σ level were generated for 918 of these targets. A search for additional TCEs in potential multiple planet systems was conducted in DV through calls to TPS. A total of 1235 TCEs were identified in the SPOC pipeline

³https://archive.stsci.edu/missions/tess/catalogs/targetinfo/tess_multisector_42_43_drn63_targetinfo_v01.txt

Table 1: Sectors Searched

Sector #	Physical Orbits	Start TJD ^a	End TJD	Data Release #
42	91,92	2447.685	2473.159	60
43	93,94	2474.162	2498.888	62

^a TJD = TESS JD = JD - 2,457,000.0

Table 2: Targets in this Data Release With Number of Sectors Observed

Number of Sectors	Target Count
2	11160

on 918 unique target stars that completed analysis in DV. Table 3 provides a breakdown of the number of TCEs by target. Note that targets with large numbers of TCEs are likely to include false positives.

Figure 3 gives the distribution in period–transit depth space of the TCEs found in the multi-sector search. The top panel shows the distribution of orbital periods for the TCEs. After rapidly declining for periods out to 5 days, the distribution shows a broad tail with several overdensities towards the longest period allowed ($\lesssim 50$ day) while requiring at least two transit events.

The vertical histogram in the right panel of Figure 3 shows the distribution of transit depths derived from limb-darkened transiting planet model fits for TCEs. The model transit depths range down to the order of 100 ppm, but the bulk of the transit depths are considerably larger.

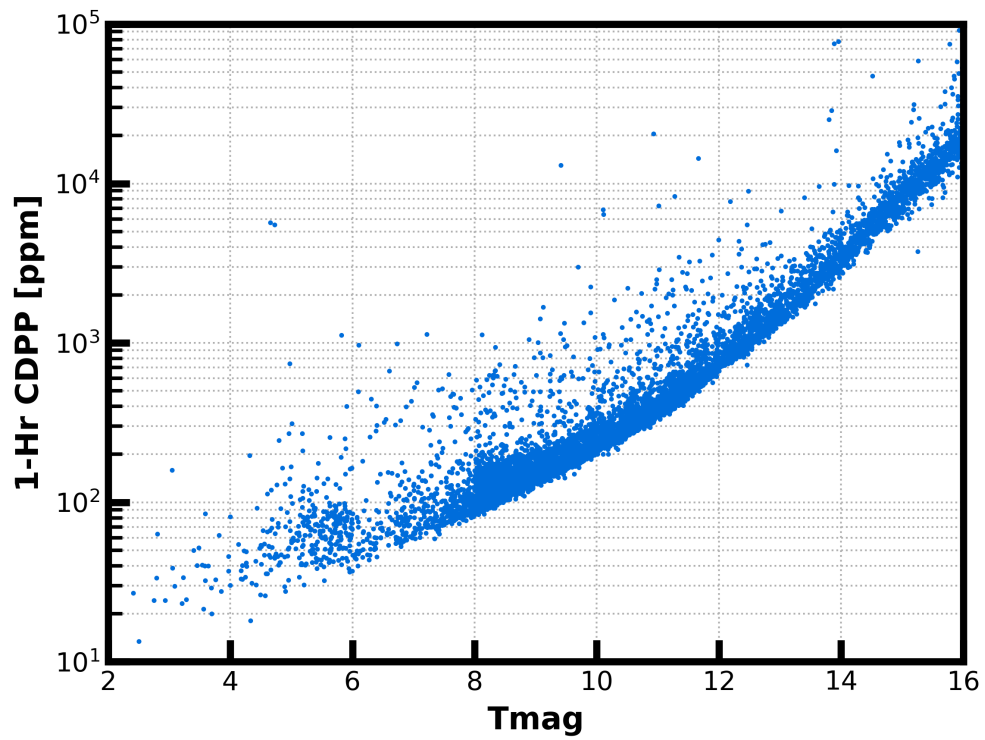


Figure 2: 1-hour CDPP. The points are RMS CDPP measurements for the 11160 light curves from the Sectors 42 – 43 multi-sector search plotted as a function of TESS magnitude.

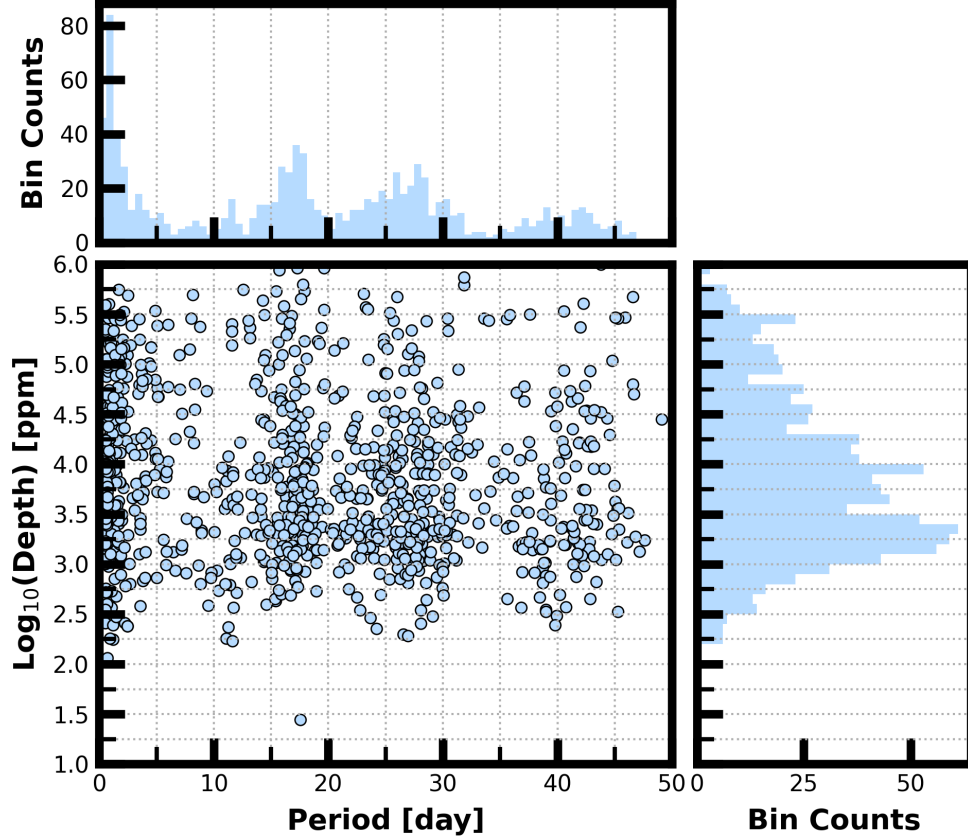


Figure 3: Lower Left Panel: Transit depth as a function of orbital period for the 1235 TCEs identified for the Sectors 42 – 43 multi-sector search. For enhanced visibility of long period detections, TCEs with orbital period < 3.0 day are not shown. Reported depth comes from the DV limb darkened transit fit depth when available (or the DV trapezoid model fit depth if the limb darkened transit fit is not available). Top Panel: Orbital period distribution of the TCEs shown in the lower left panel. Right Panel: Transit depth distribution for the TCEs shown in the lower left panel.

Table 3: Sector 42 – 43 TCE Numbers

Number of TCEs	Number of Targets	Total TCEs
1	697	697
2	148	296
3	53	159
4	18	72
5	1	5
6	1	6
–	918	1235

References

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Acronyms and Abbreviation List

BTJD Barycentric-corrected TESS Julian Date

CDPP Combined Differential Photometric Precision

Dec Declination

DV Data Validation Pipeline Module

KDPH Kepler Data Processing Handbook

MAST Mikulski Archive for Space Telescopes

MES Multiple Event Statistic

NAN Numerical Not-A-Number

POC Payload Operations Center

ppm Parts-per-million

RA Right Ascension

RMS Root Mean Square

SDPDD Science Data Products Description Document

SNR Signal-to-Noise Ratio

SPOC Science Processing Operations Center

TCE Threshold Crossing Event

TESS Transiting Exoplanet Survey Satellite

TIC TESS Input Catalog

TIH TESS Instrument Handbook

TJD TESS Julian Date

TOI TESS Object of Interest

TPS Transiting Planet Search Pipeline Module

UTC Coordinated Universal Time

XML Extensible Markup Language